INTERMOUNTAIN STATION
Central Reference File
No. 0.73

FOREST SERVICE
RECEIVED
MAR 17 1949
RESEARCH
INTERMOUNTAIN

Research Note

NORTHERN ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

No. 70 Missoula, Montana December 1948

# THIRTY-NINE YEARS' GROWTH IN A CUT-OVER LARCH STAND

By

Arthur L. Roe

There has been much interest in selective cutting in the larch-fir type in western Montana. Western larch is regarded as the most desirable of the more abundant species in larch-fir stands. Hence, one criterion for judging the success of selective cuttings in this type is to compare the amount of larch volume increment with that of its associated species of lesser importance.

In 1908-09, the Forest Service made what amounted to an economic selective cutting in a larch-fir stand on the east side of Seeley Lake in the Big Blackfoot River drainage. A detailed study made in the Seeley Lake cut-over area in 1947 now provides growth results from a cutting made 39 years ago. It shows that total net volume growth of larch was surpassed by that of the more tolerant species such as Douglas-fir, grand fir, alpine fir, and Engelmann spruce. The study also demonstrates that a large proportion of the ingrowth was contributed by the less desirable species. Thus, it verifies once again the importance of controlling species composition when the objective of management is to continue larch production. Does selective cutting in this type, then, meet the objective of obtaining maximum volume growth of larch?

The original stand before cutting ranged from 24,000 to 29,000 board feet per acre in trees 10 inches d.b.h. and larger. It was composed of western larch, Douglas-fir, and lodgepole pine as the major species, with ponderosa pine, alpine fir, and Engelmann spruce as minor associates. Western larch made up about 52 percent of the stand volume. Pole size trees of Douglas-fir and lodgepole pine were numerous with fewer Engelmann spruce and alpine fir trees. Larch and ponderosa pine trees in the pole size class were scarce. Age of the trees in the merchantable stand varied from about 200 up to 500 years. The productiveness of the site, as measured by the larch site quality classification 1/, is about equally divided between site classes III and IV.

---

1/ Larch-Douglasfir Board Foot Yield Tables by L. J. Cummings, Northern Rocky Mountain Forest and Range Experiment Station, Applied Forestry Note No. 78.

INT - FILE COPY

The object of marking was to increase growth of larch and ponderosa pine in the residual stand. Douglas-fir was marked heavily for cutting because of its defective condition. Lodgepole pine and the true firs were classed as undesirable and all such trees that were merchantable were cut. Ponderosa pine and western larch trees 18-20 inches d.b.h. and larger were marked for cutting. Douglas-fir and Engelmann spruce 14-15 inches d.b.h. and larger, and lodgepole pine, alpine fir, and grand fir 10-11 inches d.b.h. and larger, were likewise marked for cutting. Before cutting, larch contained 52 percent of the volume in the stand. Cutting resulted in increasing the percentage of larch to 58.

Many stand conditions were found on the area. In some places, most of the larch had been removed. In other places, much larch had been left. To simplify the study, four types of reserve stands were selected to represent different intensities of cutting. Larch was represented in the reserve stands as follows:

| Reserve stand Volume per acre 1/ | Percent of total volume in western larch trees |
|---|---|
| Bd. ft. | Percent |
| 1,200 | 26.3 |
| 4,000 | 56.5 |
| 5,300 | 77.4 |
| 11,000 | 82.7 |

1/ The values in this column have been rounded off to the nearest 100 bd. ft. for ease of inspection. Actual values are 1227, 3984, 5329, and 10,668 bd. ft., respectively.

Growth data were obtained on a total of forty 1/5-acre plots located within these four stands.

## Results

### Combined Growth of All Species for the 39-Year Period

The following table gives the total growth by reserve stands for the thirty-nine-year period after logging:

| Reserve stand volume | Total net growth | Growth as percent of reserve stand |
|---|---|---|
| Bd. ft. | Bd. ft. | Percent |
| 1,200 | 3,348 | 273.0 |
| 4,000 | 4,143 | 103.9 |
| 5,300 | 3,919 | 73.5 |
| 11,000 | 3,930 | 36.8 |

Total net growth was about equal regardless of the reserve stand volume. The lightest stand had nearly as much volume increment for the period as the heavy stand. This was caused by compensating factors. Seventy-four percent of the growth in the light stand was made up of ingrowth, as contrasted with only 30 percent in the heavy reserve stand. The two intermediate stands had moderate amounts of ingrowth. Volume increment on the residual trees was much greater in the heavier reserve stands. Thus, the combination of high ingrowth and low residual tree growth in the light reserve approximately balanced low ingrowth and high residual tree growth in the heavy reserve stands.

Comparison of Growth Rates by Species

Mean annual growth rates of the different species have been combined into two groups in Figure 1 for ease of comparison. Bars on the left side of the center line show ingrowth, residual tree growth, and mortality of the intolerant larch and lodgepole pine, both of which respond to cutting in a similar manner. Western larch contributed none of the ingrowth shown under the intolerant species in the 1200 board foot reserve stand, and only one quarter and one half of the ingrowth in the 4000 and 5300 board foot stands respectively. Lodgepole volume increment was of little consequence. Growth rates of the remaining species - Douglas-fir, alpine fir, Engelmann spruce, and ponderosa pine - are shown on the right side of the figure. Trees in this group, with the possible exception of ponderosa pine, are more tolerant than either larch or lodgepole pine. Douglas-fir produced most of the growth in the "tolerant" group, and ponderosa pine made up a very small part of the total.

Volume growth of western larch was exceeded by the other species in all intensities of cutting except in the heaviest reserve stand. Here, larch succeeded only in equaling the growth of the associated species. Thus, the large amount of larch growing stock was not sufficient to offset the gains made by the aggressive ingrowth and faster growth rate of reserve trees in the "tolerant" group.

Mortality

Amount of mortality was closely associated with reserve stand size. Volume loss ranged from as low as three percent of the gross growth in the smallest stand to as much as 22 percent in the largest stand. Heavy mortality occurred in lodgepole pine residuals in the late twenties and early thirties, attributed largely to mountain pine beetle (Dendroctonus monticolae Hopk.). Engelmann spruce reserve trees suffered losses by windthrow soon after logging. Other species were relatively windfirm. Total mortality is considered to be moderate.

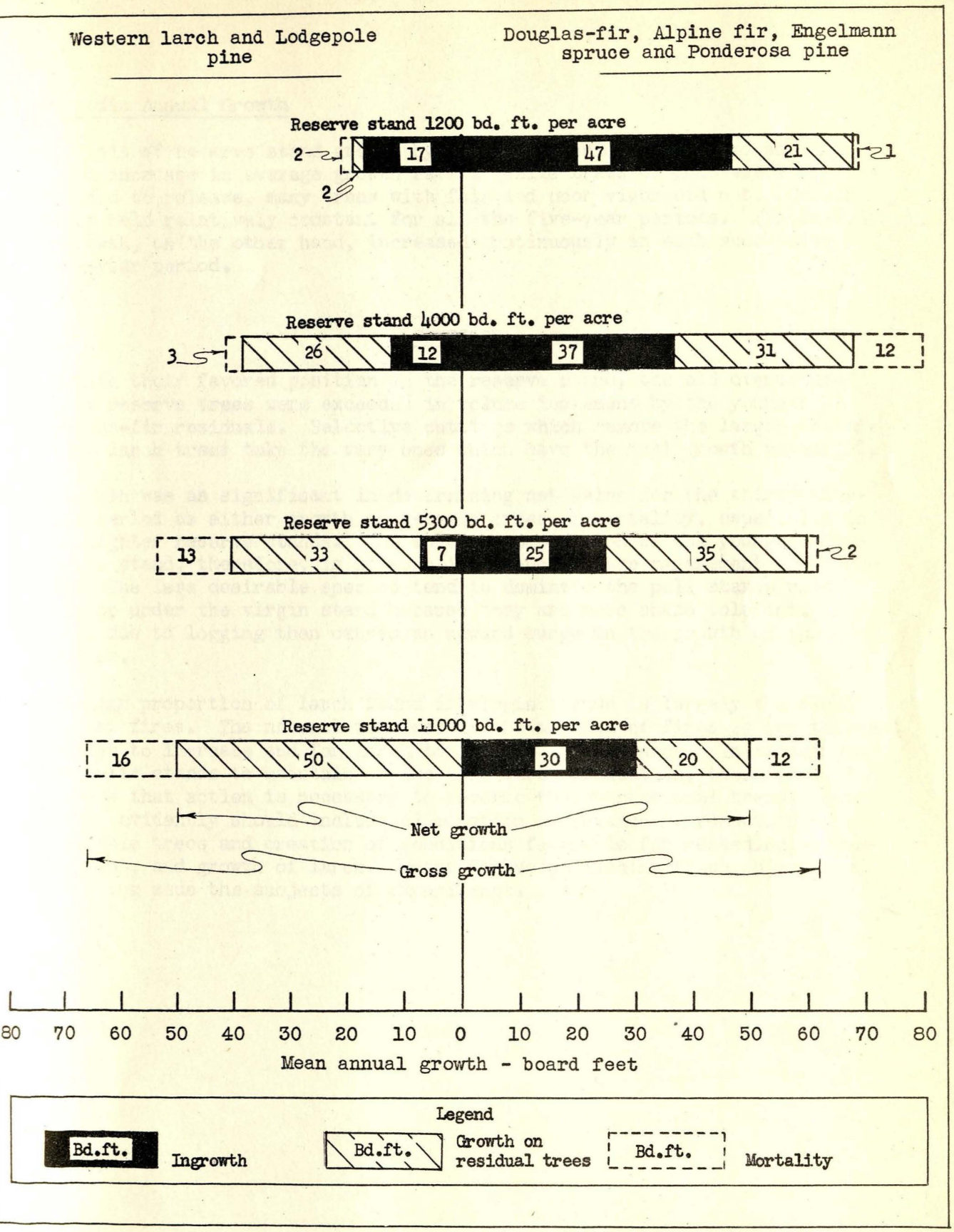


Figure 1.--Mean annual growth and mortality rates for 39-year period by reserve stand classes

## Periodic Annual Growth

Analysis of reserve stand growth by five-year periods failed to show any rapid increase in average growth rates. While trees of good vigor responded to release, many trees with fair and poor vigor did not. Growth rates held relatively constant for all the five-year periods. (Table 1.) Ingrowth, on the other hand, increased continuously in each successive five-year period.

## Discussion

Despite their favored position in the reserve stand, the old overmature larch reserve trees were exceeded in volume increment by the younger Douglas-fir residuals. Selective cuttings which remove the larger better-vigor larch trees take the very ones which have the best growth potential.

Ingrowth was as significant in determining net gains for the thirty-nine-year period as either growth on reserve trees or mortality, especially in the lighter reserve stands. The species composition of the younger trees in the stand, therefore, is of much importance in the management of larch-fir. The less desirable species tend to dominate the pole stands which develop under the virgin stand because they are more shade tolerant. Release due to logging then causes an upward surge in the growth of those species.

The high proportion of larch found in virgin stands is largely the result of past fires. The natural tendency in the absence of fires is for tolerant species to increase and for larch to decline in abundance. In managing larch-fir stands to maintain or increase larch production, therefore, it appears that action is necessary to reverse the successional trend. Such action evidently should include elimination of advance reproduction of undesirable trees and creation of conditions favorable for reseeding, establishment, and growth of larch. Means for accomplishing these objectives are being made the subjects of experiments.

Table 1.--Periodic annual gross growth of western larch residual trees

| Reserve stand volume 1/ | Five Year Period Following Logging | | | | | | | | Mean annual growth 3/ |
|---|---|---|---|---|---|---|---|---|---|
| | 0-5 | 6-10 | 11-15 | 16-20 | 21-25 | 26-30 | 31-35 | 36-39 2/ | |
| Bd.ft. | Bd.ft. | Bd.ft. | Bd.ft. | Bd.ft. | Bd.ft. | Bd.ft. | Bd.ft. | Bd.ft. | Percent |
| 1,200 | 2 | 4 | 2 | 3 | 4 | 3 | 5 | 5 | 1.11 |
| 4,000 | 38 | 27 | 27 | 25 | 24 | 25 | 27 | 26 | 1.25 |
| 5,300 | 44 | 39 | 49 | 47 | 50 | 46 | 42 | 46 | 1.20 |
| 11,000 | 69 | 64 | 53 | 67 | 52 | 60 | 75 | 68 | .74 |

1/ Reserve stand volume includes trees of all species 10 inches d.b.h. and larger.

2/ This period is only four years in length.

3/ Percent mean annual growth is based on the larch volume only in the reserve stand.